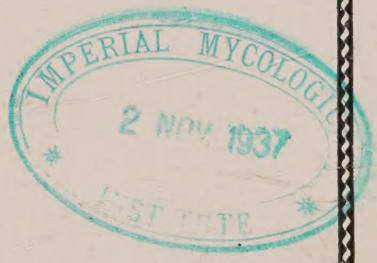
UNITED PLANTERS' ASSOCIATION OF SOUTHERN INDIA

TEA SCIENTIFIC DEPARTMENT

ANNUAL ADMINISTRATION REPORT

FOR

1936-37



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OF

TEA SCIENTIFIC DEPARTMENT

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TEA SCIENTIFIC DEPARTMENT

SCIENTIFIC STAFF.

Chief Scientific Officer	..	W. S. Shaw, D.Sc., Ph.D., M.Sc., F.I.C.
Asst. Tea Scientific Officer	..	K. B. W. Jones, Ph.D., B.Sc., A.R.C.Sc., A.I.C.
Entomologist	..	S. Ananda Rau, M.Sc.
Mycologist	..	M. K. Subba Rao, B.Sc.
Soil Chemist	..	V. Jayaraman, B.A., B.Sc. (*Ag.*)

U. P. A. S. I.

TEA SCIENTIFIC DEPARTMENT

ANNUAL REPORT 1936-37.

Staff :—There have been no changes in staff during the year.

The Chief Scientific Officer was on Home Leave for six months returning on the 7th February. During his absence the Assistant Tea Scientific Officer took charge at the Experimental Station.

Advisory Work :—Letters received during the year numbered 1465 and letters despatched amount to 1531. This represents a gradually increasing number of enquiries demonstrating that the Department is being employed to a greater extent than in previous years.

Publications :—During the year 4 publications have been issued. These are :—

Bulletin No. 9 Tea Manufacture in South India by Dr. K. B. W. Jones.

Bulletin No. 10 Pink Disease by Mr. M. K. Subba Rao.

Memoranda on the History, Activities, and Policy of the Upasi Tea Scientific Department.

Planting Problems in South India.

Bulletin No. 9 reproduced in book form material published in the "Planters' Chronicle" during the previous year with the addition of an index. This Bulletin has had a good reception and it has now become necessary to consider a Reprint. It is also being abstracted in serial form in a Java Publication 'De Bergculture.'

Bulletin No. 10 had been awaiting publication for some time. This was circulated free of charge to all estates known to have an interest in Pink Disease and free copies can also be obtained on request by other members.

Memoranda on the History, Activities and Policy of the U. P. A. S. I. Tea Scientific Department, has not been ranked as a Bulletin as it is concerned only with matters of administration. This publication includes a Memorandum on the U. P. A. S. I. Tea Scientific Department by the Chief Scientific Officer and Notes on the Department by Mr. E. H. Francis, Tea Member of the U. P. A. S. I. Executive Committee. These constituted the data on the Department submitted to Professor Engledow in Calcutta in January 1936.

There is added a joint report by Mr. E. H. Francis and Dr. Shaw on interviews with Professor Engledow and the Scientific Commission of Inquiry.

Finally a reprint is included of an address given by the Assistant Tea Scientific Officer at a meeting of members of the South Indian Association in London on the subject of the activities of the Department.

It is hoped that the publication will provide information concerning the Department which will tend to reduce the occurrence of criticisms based on a lack of exact knowledge.

Planting Notes embody the replies of the Department to problems raised by Planting Associations in response to a questionnaire issued by the Department in 1935. This again is not ranked as a Bulletin as it contains few new facts or new ideas but only records the Department's opinion on a number of points on which some guidance was requested.

Pests and Diseases :—The chief item of interest in this connection has been a recrudescence of Shot Hole Borer on certain estates in Central Travancore.

Reference was made to the occurrence of this pest in the Annual Reports of the Department for 1927/28 and for 1928/29. In the latter it was pointed out that on estates showing only sporadic attacks of the pest manuring should be supported by the more aggressive campaign of burning all infected branches.

In August 1936 specimens of Shot Hole Borer were received from another estate in Central Travancore and it was found that there had been a distinct increase in Shot Hole Borer during the last pruning cycle. The Entomologist was sent to the district to investigate and report.

The Entomologist found that the pest was present on a number of estates but that it was not yet widespread, and direct measures of control could still be taken with advantage.

In Ceylon the extent of attack is so great that direct measures are impracticable and the best thing to be done is to apply manure in order to maintain the vigour of the bushes and minimise the effects of the infestation. The attacks in South India, however, are localised and consequently direct action was again recommended by an injunction to burn all prunings immediately. In the opinion of the Department it would be better to take drastic measures over the small acreage at present affected rather than adopt a policy which will almost certainly result in a permanently recurring and increasing expenditure in order to maintain crop.

Touring :—The Assistant Tea Scientific Officer attended by invitation the Annual General Meetings of the South Travancore, Central Travancore, Mundakayam and Anamallais Districts in May 1936, and gave a short address at each. In March 1937 Dr. Jones gave by request an address on composts at a meeting of the Nilgiri P. A.

Touring is again becoming a prominent feature of the Department's activities, and during the coming year extensive touring is proposed.

Future Policy of the Department :—Reference has already been made to the interviews with Professor Engledow and the Scientific Commission of Enquiry in Calcutta by Mr. E. H. Francis and Dr. W. S. Shaw.

Professor Engledow had no terms of reference with respect to South India and the published Report of the Commission of Enquiry deals specifically only with N. E. India. Nevertheless the interviews with Professor Engledow and the general principles laid down in the Report of the Engledow Commission are of interest to South India and provide a basis for suggestions on the future policy of the Department.

The following points from the Report will serve as indication of the guidance provided.

The purpose of an Experimental Station is twofold, to employ the sciences for the economic betterment of the industry, and by appropriate advisory work to help planters to use fully all the assistance the sciences can offer.

Also, 'That in so far as it is practicable it is in the ultimate interest of all tea producing countries to join together in advancing knowledge of the tea plant and of tea making'.

The most important problems to be studied are plant-breeding and the chemistry of tea.

Advisory Officers are desirable in order to promulgate the results and conclusions reached by the central research station, in order to carry out local trials of experiments which appear promising at the central station, and in order to keep the central station informed of local peculiarities.

Suggestions were made for the increase in staff necessary at Tocklai in order to fulfil these conditions.

Applying these comments to South India the only points where any difference of opinion seems justified is in the emphasis on plant breeding. Plant breeding would be intended to increase quantity or improve the quality of the crop. The introduction of an improved jat will involve replanting large areas before much benefit is felt. Now in South India increases in crop are not generally required at the moment and if they are required in future years it is possible to use fertilisers or to extend the planted acreage. Most of the tea in South India is young and replanting is not likely to be considered here although this may be of importance in N. E. India. Moreover until chemical investigations throw more light on quality it will be very difficult for plant breeders to test their material in this respect so that the prospect of improving quality and of guaranteeing such an improvement is somewhat remote.

The importance of the chemistry of tea has long been recognised in South India and it has always been regretted that the prior claims of advisory work and other enquiries have prevented more advances being made in this direction.

Finally, the expansion of staff recommended in N. E. India is also required in South India.

It is understood that steps have already been taken to increase the staff in N. E. India by five European Officers, a Chemist, and Entomologist and three Advisory Officers. The cost of these additions raised the required cess per acre in North East India from 7as. to 11as.

Now, a consideration of the comparative costs of production and price realised for tea in N. E. India and South India respectively would indicate that South India is in a position to afford as much per acre as N. E. India. Actually much needed expansion could be put into effect at a smaller figure than this.

The following extract of minutes of Tea Scientific Sub-Committee meetings are noteworthy to show that this matter has been carefully investigated:—

"The Sub-Committee decided to recommend to the U. P. A. S. I. that the South India Tea Scientific Station should take its place in the international co-ordination scheme recommended by the Commission of Enquiry.

"1. The Sub-Committee, after discussion with Dr. Shaw, was of opinion that the South Indian Station would be capable of doing its fair share of the work in the co-ordination scheme without any increase in the cess (based on the present acreage), but it must be clearly understood that the first call on the Scientific Staff would be work allotted to it under the co-ordination scheme. Most of the advisory work could still be carried out, but touring would have to be largely eliminated.

"2. As the results of all work, carried out at other stations, would be available to South Indian Planters, a liason officer to interpret and demonstrate these results would be necessary if all the interests are to receive the maximum benefit. This would necessitate the employment of an agriculturist thereby increasing the cess to -/8/- per acre on the present acreages.

"After full discussion the Sub-Committee emphatically recommended to the U. P. A. S. I. that it should accept the latter alternative."

According to a detailed scheme submitted to the Tea Scientific Sub-Committee the cost of an additional Agricultural Officer would be one anna three pies per acre for the first year rising to one anna six pies in the fourth year assessing a subscribing acreage of 125,000 acres.

The reorganization of the U. P. A. S. I., and the temporary uncertainty occasioned by the suggestion of a voluntary cess to the Scientific Department, rendered it impracticable to press for any definite action in regard to the future policy of the Department but it is hoped that constructive action may be taken when the new Tea Product Committee is able to attend to this important matter.

Composts :—Widespread interest in composts has continued during the year, and the Department has continued to carry out analyses of all samples submitted for report on the quality of these samples and to advise on all questions raised concerning the manufacture and application of composts.

The opinion of the Department on composts remains the same as that reported in last year's Annual Report. In this connection there appears to be considerable misconception of the Department's attitude towards composts. It must be stated with emphasis that the Department is not antagonistic to composts and is fully aware of their value as an agricultural aid to soil fertility. The fundamental question which the Department has endeavoured to answer for South India *as a whole* are (i) Are Composts necessary under South Indian soil conditions? and (ii) can they be produced and applied economically? Taking South India generally, the Department takes the attitude that composts are not necessary as an estate practice and that the economics of compost manufacture preclude their employment on a large scale. These questions should be answered for an individual district, or even an individual estate. before a decision on the value of composts can be made. Thus, an estate may possess areas on which tea development is poor owing to obviously poor soil conditions. The answer in this case to the first question would be affirmative. The cost of compost manufacture and the situation of the poor area with respect to transport would give an answer to the second question. If this answer is also affirmative, then the value of application of composts under such conditions is undisputed.

The object of the Department's publications and statements on the subject of composts has been to indicate the lines along which a decision with

regard to composts may be made, and not to make the actual decision. It can only make the decision if the conditions existing on the estate are precisely known.

During the coming year experiments are being commenced on the Station and on a neighbouring estate for the purpose of comparing the effects of composting with those of green manuring and artificial fertilisers.

A summarised table is given of the analysis of the numerous compost samples analysed during the year.

The average compost appears to be an improvement on the average compost of last year as it contains slightly more humus, a better carbon/nitrogen ratio and is richer in nitrogen, phosphate and potash. It is possible that this is due to some extent to the use of richer raw material as it is noticeable that green manures and dadap loppings feature prominently in the data given concerning the raw materials used. This is not necessarily an advantage as it suggests that material from tea fields is being used as raw material. In the absence of other more suitable raw material the only justification for this is when the compost so produced is applied to poor areas. Under present conditions little harm can be done by a transference of plant food and humus from richly supplied fields to the poor fields, but greater profit is likely to be made by the transference of plant food and humus to the poor areas from uncultivated and valueless land.

SUMMARY OF COMPOST ANALYSES

	No. of Samples	% Moisture	% Loss on Ignition	% Nitrogen	C/N. Ratio	% Phosphate	% Potash
			Kanan Devans				
1	27	35.8	19.7	0.67	11.8	0.36	1.21
2	1	57.5	17.5	0.61	13.2	0.38	1.07
3	3	42.9	20.6	0.65	14.3	0.24	0.76
4	6	62.8	14.3	0.51	12.6	0.22	0.76
5	4	53.6	17.3	0.48	14.4	0.21	0.82
6	4	65.2	14.9	0.52	13.0	0.37	1.14
7	4	36.7	19.4	0.54	13.5	0.15	0.56
8	3	54.4	16.2	0.51	14.1	0.25	0.66
9	8	58.7	16.1	0.51	15.1	0.24	0.59
10	4	44.6	13.2	0.45	12.5	0.28	0.42
11	1	47.0	17.2	0.39	18.0	0.19	0.73
12	19	55.2	13.0	0.42	12.9	0.25	0.53
13	5	51.2	19.3	0.56	16.2	0.23	0.52
14	4	65.9	14.9	0.48	14.9	0.16	0.60
15	1	55.1	12.4	0.42	14.5	0.28	0.52
16	1	57.5	13.7	0.50	14.0	0.33	1.17

	No. of Samples	% Moisture	% Loss on Ignition	% Nitrogen	C/N. Ratio	% Phos-phate	% Potash
			Central Travancore				
1	3	40.2	14.8	0.45	11.9	.20	.63
2	2	31.7	12.9	0.37	13.9	.19	.41
3	3	16.5	21.5	0.67	11.3	.44	.95
4	3	46.4	15.8	0.66	10.8	.39	1.09
5	10	38.1	14.3	0.63	11.3	.19	.45
6	7	41.7	23.4	0.78	13.8	.37	.89
7	1	43.5	15.0	0.48	12.5	.78	1.52
8	5	45.1	15.6	0.55	13.2	.31	.90
9	1	50.1	13.6	0.44	12.2	.26	.45
10	2	19.6	12.5	0.40	11.3	.21	.52
11	2	12.1	19.3	0.49	13.9	.32	.78
12	1	61.8	14.5	0.51	12.5	.25	.59
13	2	35.4	26.6	0.96	12.9	.33	.85
14	7	36.8	19.5	0.74	11.6	.44	1.15
15	1	53.9	17.9	0.67	11.2	.38	1.03
16	2	55.2	12.0	0.34	15.1	.17	.58
17	7	32.2	20.3	0.76	12.3	.36	.85
18	3	33.9	22.3	0.73	14.9	.38	.63
			South Travancore and Mundakayam				
1	3	46.3	16.8	.70	11.2	.31	.93
2	2	44.6	18.5	.59	12.9	.27	.42
3	2	44.0	18.4	.77	11.5	.39	.77
4	3	48.5	18.8	.70	11.0	.30	1.04
5	7	40.2	23.6	.83	14.5	.27	.75
6	4	45.7	22.2	.93	11.4	.28	.53
7	4	53.7	15.5	.65	11.4	.26	.52
8	1	42.2	15.1	.48	13.5	.23	.74
9	3	30.3	19.9	.62	13.3	.37	.72
10	4	57.7	16.8	.68	11.8	.38	.97
			Wynaads, Nilgiri and Malabar				
1	3	47.9	18.5	.64	10.8	.40	.55
2	11	49.4	15.0	.56	11.7	.34	.64
3	7	32.9	22.6	.81	11.2	.38	1.24
4	2	49.4	17.0	.67	10.9	.51	.45
5	1	47.5	14.9	.41	14.6	.19	.25
6	19	50.6	13.9	.45	13.6	.20	.52
7	1	62.5	12.8	.48	10.4	.19	.25
8	6	54.3	21.0	.60	11.5	.42	.66
9	12	47.4	14.3	.48	13.3	.24	.59
10	5	49.4	16.9	.69	11.9	.34	.49
11	4	32.7	15.8	.49	11.4	.35	.96

Wynaads, Nilgiri and Malabar—(*Contd.*)

Central Travancore	No. of Samples	% Moisture	% Loss on Ignition	% Nitrogen	C/N. Ratio	% Phosphate	% Potash
12	11	36.1	22.8	.87	12.2	.36	1.05
13	3	53.6	15.1	.62	10.8	.36	1.16
14	1	54.4	15.8	.48	14.0	.28	.36
15	3	28.8	24.2	.81	12.5	.69	1.63
16	19	55.3	14.6	.50	13.5	.22	.56
17	13	46.4	16.8	.59	12.4	.27	.72
18	16	55.7	15.0	.48	13.7	.19	.46
19	10	57.2	15.2	.55	14.0	.30	.58
20	2	52.2	16.8	.68	11.3	.31	.70
			Other Districts				
1	2	32.7	12.1	.32	12.8	.45	.45
2	1	46.7	17.3	.64	11.1	.36	1.63
3	1	39.8	29.4	1.77	12.3	.45	1.28
4	1	6.3	42.0	1.65	11.1	.46	1.02
5	5	51.9	14.1	.39	15.1	.25	.44
6	8	62.8	14.0	.52	12.7	.21	.81
7	2	61.3	23.1	.93	12.5	.29	.57
8	1	46.2	16.1	.57	12.0	.34	.75
*Average		45.8	17.8	.625	12.9	.32	.77

* Derived from 72 Estates and 362 Compost Samples.

Laboratory :—During the short time at his disposal upon return from leave, the Chief Scientific Officer has been able to obtain further information on the chemistry of tea especially in relation to theotannin and caffeine theotannates. Some interest in the chemical work of the Department is being shown in Java, Ceylon, and in England, where attempts have been commenced to substantiate the views of the Department. It is gratifying to be able to record the interest of Mr. P. A. Keiller of Ceylon in the chemical work, and to observe that figures which he has determined substantiate the fundamental observation made in the Department's publication "The Nitrogen Distribution of Tea" that water soluble protein is practically non-existent in green leaf.

METEOROLOGICAL

Month.	Rainfall.	No. of days with rain.	Average Afternoon Maximum	Average Overnight Minimum.	Humidity		Vapour Pressure.		Cloud.	
					8-30 A.M.	3-0 P.M.	8-30 A.M.	3-0 P.M.	8-30 A.M.	3-0 P.M.
April ..	2.13	6	83.4	65.0	84.5	64.4	21.8	22.7	4.6	3.9
May ..	9.44	16	81.3	65.9	90.0	71.1	23.4	23.8	5.5	6.4
June ..	21.96	29	72.5	64.5	91.0	90.9	21.2	22.3	7.8	9.4
July ..	16.10	29	73.1	64.4	91.7	88.4	20.9	21.7	8.6	9.0
August ..	7.54	25	73.6	63.7	92.0	83.6	21.1	21.8	7.8	8.6
September	5.57	19	77.0	64.2	91.0	80.0	21.8	23.2	5.5	7.5
October ..	9.34	17	76.9	63.7	87.8	79.2	21.4	22.2	5.8	7.3
November	5.00	12	75.7	63.3	91.9	76.4	21.0	20.9	5.5	7.3
December	0.02	1	77.7	60.4	89.9	61.9	18.1	18.1	4.5	4.1
January ..	—	—	79.9	58.5	88.5	45.5	17.4	15.1	2.2	1.8
February	0.95	6	81.9	61.7	93.2	58.6	20.5	19.5	3.5	4.0
March ..	1.29	8	82.3	62.9	80.5	58.0	20.4	20.9	2.5	4.3
Total ..	79.34	168								

Total rainfall for the year was slightly below average but fluctuations in the distribution were noteworthy. Only 1.03 inches fell between April 4th and May 12th and this period of relative drought did much to counteract the benefit derived from earlier rains. August, September and October were marked by small falls and an absence of heavy rains. The rain which are usually anticipated about the end of December were absent and although there were a few showers in February and in March these were probably too light to be useful.

As usual the remaining meteorological data recorded were approximately normal, small deviations being usually traceable to the influence of rainfall.

Buildings :—On Mr. T. E. Howe's recommendation the roof of the Chief Scientific Officer's Bungalow was redesigned and replaced, a slight change being made in the plan of the bungalow at the same time. The new roof was lower and cement asbestos ceiling sheets were erected in five rooms as protection against the sun.

English sanitation was installed in this bungalow at the same time.

Electric Light Supply :—The subject of employing Pykara electric power in place of the existing scheme has been under consideration, but in view of the capital outlay on the present engine and the replacement of batteries which has been fully acquired it was decided to defer this change over until the present batteries have been exhausted.

Acknowledgment :—It is a pleasure to record appreciation of the members of the Tea Scientific Sub-Committee, the help given by the Agents

and Manager of Ambanaad Estate in the conduct of spraying experiments, and to acknowledge gratefully the hospitality given to members of the Staff while on tour.

Thanks are due to the Principal and Staff of the Agricultural College at Coimbatore for valuable assistance in the shape of the loan of books from the library and by the identification of botanical specimens; to the Imperial Institute of Entomology and the Imperial Bureau of Mycology, for the identification of specimens; and to Dr. H. H. Mann of the Imperial Bureau of Soil Science for his personal interest in certain soil problems.

PLOT DETAILS

Old Tea.

This area was pruned in October but the yield previous to this was very satisfactory, being the highest so far obtained in a pruned year. The pruning carried out was a clean prune leaving rim lungs. There was still much knotted wood to remove and many bushes were collar pruned. It is hoped that in 1940 frame renovation will be complete on all bushes of good jat.

Month	Green Leaf		Made Tea per acre	
	During Month	Total	During Month	Total
April	1083 lbs.	..	90	..
May	455	1538	38	128
June	652	2190	54	182
July	746	2936	62	244
August	776	3712	65	309
September	861	4573	72	381
October	625	5198	52	433
November	22	5220	2	435
December	24	5244	2	437
January	19	5263	2	439
February	16	5279	1	440
March	267	5546	22	462

Yield	1926/27	486
,,	27/28	494
,,	28/29 Part Pruned	289
,,	29/30	506
,,	30/31 Half Pruned	421
,,	31/32 Half Pruned	342
,,	32/33	401
,,	33/34 Pruned December 1933	237
,,	34/35	336
,,	35/36	654
,,	36/37 Pruned October 1936	462
Average yield over 11 years		421

1926 Plot

This plot having been pruned in March 1936 was not brought into plucking until the beginning of September. This area continued to look well until the beginning of March when the drought caused defoliation of many of the weaker bushes particularly in plot 5.

During March the area was divided into a number of small plots of about 150 bushes each and in some cases rows of bushes have been taken out in order to improve the delineation of these plots. This has caused slight adjustments of areas.

The 1926 plots have always suffered badly from grass but this is diminishing as the cover of the tea improves. During the past year however it became infested with Drymaria cordata and it will be interesting to see how this affects grass during the coming year.

1926 Plot Yields

Pounds of Made Tea per Acre.

Month	Sub-Plot No.					
	1	2	3	4	5	6
April to August ..	Out of Plucking owing to Pruning					
September ..	61	64	53	43	30	24
October ..	95	84	64	54	50	57
November ..	65	62	58	39	35	35
December ..	93	83	73	81	57	61
January ..	50	51	55	35	28	44
February ..	19	28	30	28	18	29
March ..	16	15	26	19	17	31
Total ..	399	387	359	299	235	281

1927 Plot

This area was pruned in the middle of April 1936 and was not brought into regular plucking until the end of September.

Yields were again recorded from 30 plots of 100 bushes. Records of initial fertility over a complete pruning cycle are now available and it is hoped to start field experiments on this block during the present year.

Yields recorded are as follows :—

Sub-Plot	Yields in pounds of Green leaf.		
	Half Section A	Half Section B	Total
1	50½	52	102½
2	48	47½	95½
3	45	39½	84½
4	45	31	76
5	62	29½	91½
6	72	44½	116½
7	61½	49	110½
8	72	53	125
9	64	60	124
10	63	54	117
11	52½	46	98½
12	46	43	89
13	47	40½	87½
14	47	42	89
15	49	40	89
Total ..	824½	671½	1,496

This is equivalent to a yield of 394 lbs. per acre.

1928 Plots

The main block comprising Sub-Plots 15-18 gave a yield equivalent to 1,310 lbs. made tea per acre, which is highly satisfactory for tea without shade and without manure. This high yield is attributable to close planting, 4′ x 4′ triangular, a high percentage of effective bushes (97 per cent.) and to deep cultivation.

This tea is now due for pruning and some parts have been badly affected by drought. In the following table are shown the yields for the subdivisions of each plot :—

Pounds Made Tea per acre.

	15 Betjan	16 Dangri	17 Dhonjan	18 Nellimunda
Section 1 ..	1350	1555	1410	1785
Section 2 ..	1315	1020	1080	1575
Section 3 ..	1025	1020	1135	1385
Section 4 ..	1185	1245	1200	1195
Section 5 ..	1320	1595	1460	1515
Average ..	1240	1285	1255	1490

Plots 19—22

These plots have also yielded well during the year. The following table brings up to date the comparison between yields from plots originally high pruned and low pruned as given in previous reports :—

Year	Average yield of sub-plots 19 and 21	Average yield of sub-plots 20 and 22	Average yield of sub-plots 15 to 18
1930/31 ..	56	—	—
1931/32 ..	183	88	66
1932/33 ..	636	344	395
1933/34 ..	770	706	755
1934/35 ..	402	279	450
1935/36 ..	965	943	1078
1936/37 ..	1449	1396	1310
	4461	3726	4054

1928 Contour

This area was in plucking throughout the year but the crop fell as usual during the dry weather particularly in Sub-Plot 24. The annual yields show an increase. They were as follows :—

Sub-Plot 23	..	902 lbs. made tea per acre.
,, ,, 24	..	496 ,, ,, ,, ,, ,,
,, ,, 25	..	847 ,, ,, ,, ,, ,,
,, ,, 26	..	847 ,, ,, ,, ,, ,,

1929 Plots

This area was pruned in April 1936 and brought into plucking in September. Yields for sub-plots have been as follows :—

Sub-Plot 27	..	347 lbs. per acre.
,, ,, 28	..	331 ,, ,, ,,
,, ,, 29	..	322 ,, ,, ,,
,, ,, 30	..	391 ,, ,, ,,
,, ,, 31	..	412 ,, ,, ,,

Yields of the 15 small plots in this area have now been maintained for a complete pruning cycle and it is hoped to use this area for experimental purposes during the year.

1930 Plots.

In July 1936 Sub-Plots 33—37 were again sub-divided into sections of about 200 bushes each and the yields from each of these has been recorded for every subsequent plucking. Sub-Plot 35 has not been affected by drought as much as the others. Sub-Plots 36 and 37 have only been plucked three times in nine weeks.

Yields over the whole year were as follows :—

Sub-Plot	33	..	652	lbs.	made	tea	per	acre
,, ,,	34	..	998	,,	,,	,,	,,	,,
,, ,,	35	..	1,000	,,	,,	,,	,,	,,
,, ,,	36/37 Combined		854	,,	,,	,,	,,	,,

Remaining Areas :—A portion of Sub-Plot 6 planted in 1926 where there had been an old "Atti" stump was abandoned in 1932 as tea could not be established on it. This was replanted again this year and up to the end of March there seemed to be some prospect of the majority of the plants becoming established.

Aleurites (tung oil plants) planted in 1928 are still alive but so far have shown no sign of becoming acclimatised.

REPORT OF THE ENTOMOLOGIST.

ADVISORY :—

The majority of the enquiries received during the year related to pests of tea of which Shot-hole Borer (*Xyleborus fornicatus*, Eich.), *Helopeltis*, Termites (*Calotermes* sp. nov. and *Coptotermes* sp.) and Red Coffee Borer (*Zeuzera coffeae*, Nietn.) were the most important. Tea Aphis (*Toxoptera aurantii*, Boyer), Red Slug (*Heterusia virescens*, Butl.), Bark-eating Borer (*Indarbela* sp.), Scarlet mite (*Tenuipalpus obovatus*, Donn), Lobster caterpillar (*Stauropus alternus* Wlk.), maggots in tea seed and Brown Bug (*Saissetia coffeae*, Wlk.) formed the subject of some of the other enquiries concerning tea.

Enquiries other than those pertaining to tea were in respect of the weevil borer (*Pagiophloeus umbricidus*) and Scolytids (*Xyleborus semigranosus*, Bldf. and *X. andrewesi*, Bldf.) on Grevillea, mealy bug (*Pseudococcus* sp.) on Gliricidia, Termites on Red Gum, 'ringing' beetle (*Sthenias grisator* Fb.?), shoot-borer (*Terastia meticulosalis*, Gn.), mealy bug (*Pseudococcus* sp.), and weevil (*Myllocerus viridanus*, F.), on Dadap, Shot-hole Borer (*Xyleborus fornicatus*, Eich.) and grass-hopper on Crotalaria, a root grub on Cardamom and a few other miscellaneous insects of minor importance.

In connection with the advisory work, a few words may perhaps be introduced here with regard to material sent in for identification and report. Following the examination of the material recommendations are usually made as to the various control measures which might be adopted ; but all such measures have not necessarily been tried by this Department and found successful. Moreover, in the case of certain pests, especially those that do not occur locally, opportunities for testing out the different control measures under the supervision of the Department are not always available. Many of them are therefore suggested on analogy with similar measures found useful elsewhere. In no instance, however, is anything heard as to how far they have met the needs of the particular case for which they were recommended. Planters would therefore greatly assist the Department if they could intimate whether the suggested measures have been tried and if so, with what effect. The results of their trials could thus form a very useful basis for future recommendations.

TEA.

Helopeltis :—As indicated in last year's report, spraying experiments against Helopeltis were conducted early in the year (April-July) on Ambanaad Estate in South Travancore, where through the courtesy of Mr. A. P. D. Lodge, the Superintendent, a block of tea of about 48 acres was made available for the conduct of the experiments.

A comprehensive report was drawn up after the conclusion of the experiments but as it would not be possible nor is it considered desirable to enter into the various details here, only a summary of the salient aspects covered by the report and the conclusions arrived at has been given below.

1. The experiments were undertaken with a view to determine whether, by commencing spraying in April when there is generally a light infestation and continuing the operation at intervals and so trying to keep the bushes free of the pest at the commencement of the monsoon, there would be any appreciable reduction in the severity of the pest during its season of maximum prevalence, *viz.*, July to October.

2. A block of tea of about 48 acres in extent comprising two contiguous fields of different ages from pruning was chosen. The topography of the area and the condition of its infestation at the beginning of the experiments were known.

3. The spraying apparatus and other equipment necessary for the operation were introduced with respect to the cost of spraying.

4. Fish-oil-Resin soap at 2% strength, having given satisfactory results during preliminary laboratory trials, was employed for spraying.

5. Labour and water requirements were studied.

6. The method adopted in spraying was carefully organised.

7. Of the two fields selected for the experiment, one was subjected to one application of the spray while the other received three applications at intervals.

8. Observations were made at weekly intervals by selecting at random six plots, each consisting of 20 bushes, and recording the degree of infestation of the bushes in each plot. A similar number of plots, these also containing 20 bushes each, were chosen as control and weekly observations were also made on them for comparison.

9. Analysis of results of observations made over a period of 17 weeks indicated that a marked improvement would immediately take place as a result of spraying an improvement which would continue for a few weeks. Afterwards, there was a gradual falling off in improvement which became more pronounced during the monsoon. At the end of August, whatever difference there existed previously was no longer to be seen and the sprayed plots, taken as a whole, were as heavily attacked as the non-sprayed plots.

10. In considering the economics of spraying, the various limiting factors that detract from the value of spraying are pointed out. These include the necessity for repeated applications, the ability of a small number of insects to survive the spray, the necessity for quickness in covering large areas, the consequent provision for a large number of sprayers and adequate lengths of hose, a large labour gang, an adequate water supply, the interference by rain and lastly, the ever present danger of reinfestation by migrating insects.

11. The average cost of spraying is estimated at Rs. 7-8-0 per acre per application.

12. It is concluded that spraying small areas when the rest of the attacked estate is untreated is practically useless. The heavy initial outlay on machinery and an equally heavy recurring annual expenditure if the operation should be undertaken over the entire estate would put out of court spraying as an economic means of control, especially in view of the various factors that militate against success. It is felt that the results of these experiments do not afford adequate encouragement for recommending this measure for general adoption.

13. In the present state of our knowledge, direct measures of combating the pest being mostly uneconomical, the need for emphasis on some of the indirect measures found to be beneficial is indicated.

During the month of October, *Helopeltis* was reported from an estate in the Anamallais, but as only a mutilated specimen of the insect was received, its specific identity could not be determined. The occurrence of *Helopeltis*

on tea in this district, although noticed once before, is yet very rare and the damage negligible. The present instance, however, seems to indicate signs of a slight increase in the pest as the Superintendent of the affected estate writes, "Actually very few bushes are attacked, though the incidence of attack seems to be much heavier this year, compared to the one or two stray cases noted previously. The biggest patch noticed has been 4 or 5 bushes together. Bushes are affected in tipping as well as old fields."

Shot-hole Borer :—(*Xyleborus fornicatus*, Eich.). Reports of outbreaks of Shot-hole Borer were received almost simultaneously during the month of August from several estates in the Vandiperiyar district. It was only a year previously, as indicated in the Annual Report for 1935/36, that it was possible to establish with certainty the presence of *Xyleborus fornicatus*, Eich. on tea in South India. The above reports following so closely upon this establishment were viewed with some apprehension and a tour was therefore hastily arranged in order to study the condition of the pest *in situ* and investigate the extent of its distribution in the affected district.

History of the pest and its present distribution in the District :—Six estates were visited and the presence of the borer could be detected in all except one. This latter estate, however, sent samples subsequently which indicated that the pest occurs there also.

The positive evidence of the pest on six estates of the district lends support to the belief that the pest is by no means of recent origin but must have been in existence for a number of years. Records of borers from the Vandiperiyar district date back to 1928, when one estate (now found to be infested) sent samples to the Indian Tea Association but as the beetles could not be identified definitely by its Scientific Officer no notice was taken of them. Later, in 1929, Dr. Shaw identified beetles from the same estate as Shot-hole Borer, but again owing to a controversy which then arose regarding its correct identity, the matter was not pursued further, although, in the light of present knowledge, his identification was quite correct.

Apart from the above two records, of which specimens of beetles are not available for examination, a third report was received in 1931 from another estate in the same district. The specimens of beetles accompanying this report were definitely identified as *X. fornicatus*, Eich. by the British Museum.

The occurrence of the pest on tea in South India has therefore been known for at least 9 years and it is not improbable that it has been in existence over a longer period as two of the experienced planters of the district state that they have known it for 13 and 15 years respectively.

On two of the estates visited the infestation had spread over fairly large areas, in one instance about 15-20% of the bushes in a pruned field showing marks of infestation. On the other estates, however, it was less noticeable. In these latter estates there were no pruned fields and as most of the attacked bushes show no outward sign of the pest except the powdered wood issuing out of small holes in the branches and as even these would not be conspicuous during rains, it was very difficult to gauge the extent of spread of the pest on these estates. It is only at pruning time that the extent of its damage can be determined and it is not unlikely therefore that the estates wherein the pest was less noticeable at present may harbour the pest almost to the same extent as the two estates wherein the pest was evident to a more conspicuous degree.

The pest is also believed to exist on a few Indian-owned estates and this is naturally to be expected as they adjoin some of the affected estates that were visited.

Present Status :—Although the pest is known to be distributed over several estates, evidence is lacking as to whether there has been any definite and progressive increase in the infestation from year to year since its first appearance. There is evidence, however, to show that the pest does not exist on all fields of an estate but is yet confined to odd fields and even there only to certain patches. While still in this localised condition, any direct measure adopted towards controlling the pest should exercise a beneficial check against the spread of the pest to fields and estates which have remained hitherto free from it. It seems to me that there is hardly any justification for adopting the attitude of Ceylon in pursuing the policy of '*laissez-faire*', an attitude forced upon them by the severity and wide distribution of the pest and after the failure of the various methods attempted by them.

Control :—In South India, the pest is neither so severe nor so widespread as in Ceylon and even in infested estates the attacks are still localised. When both the range and the degree of infestation are thus decidedly limited, a vigorous campaign of a direct nature, even if somewhat expensive, is entirely justifiable if it serves to keep the pest within bounds. The removal and burning of infested branches should form the main part of control work. No doubt, this treatment might tend to subject the bushes to harsh treatment but at the same time would prevent other bushes from being attacked. After all, only a small percentage of the bushes may require to be treated this way on most estates and, with intensive cultivation and manuring, there is no reason why extra pruning should present any great difficulty. It would thus appear wiser to resort to pruning and burning and thus keep a check on the pest in the early stages of attack than to risk a wider distribution of the pest to an uncontrollable extent.

The recommendation that the infested prunings should be burnt did not seem to appeal to certain Planters in the district who apparently considered that burning the green prunings during the monsoon would be impracticable. This has, however, been observed being done in the same district in the monsoon and it would appear neither so difficult nor so expensive as one would imagine at first. The prunings may be burnt on the field paths or boundaries in a series of small fires, the first fire being started with dry wood and kindlings. The Manager who carried out this work successfully gave the cost of burning as approximately seven coolies per acre.

The removal and burning of infested branches may also be criticised in that nothing is done to check the activities of the insect in plants other than tea growing in the vicinity of the tea area. True it is that this is not a measure calculated to eradicate the insect completely, but the habits of the beetle are known to be such that distribution by its own power of flight is rather slow and natural agencies like wind do not favour a rapid dissemination of the pest. Further, on none of the other plants, jungle or cultivated, growing in the neighbourhood of the infested area was the pest found to any sufficient degree to consider them as constituting a source of danger to tea. Under these circumstances, the burning of prunings is the only practical method whereby a large number of insects can be destroyed.

If in addition to the above measure, proper care be taken not to remove infested material from place to place nor to import into the estate seedlings, dadap cuttings, etc., likely to harbour the pest (as the distribution through

infested material is said to spread the insect much more rapidly than by natural agencies) the danger of the insect spreading could, to a very large extent, be minimised and the pest itself reduced to a stage of unimportance.

The value of manuring in Shot-hole Borer affected areas needs no emphasis. Although manuring makes the bushes neither more nor less attractive to the insect, yet by inducing good growth of the bushes, a rapid healing of galleries is promoted thus preventing the breakage of branches. An adequate manuring programme should therefore be included as one of the indirect measures to be adopted in controlling the pest.

In considering the desirability of undertaking control measures, there is one other aspect which cannot be overlooked. It must be remembered that the district in which the outbreak of this pest has occurred also suffers to a greater or less extent from the ravages of *Helopeltis* and Pink Disease. Any one of these is capable, independently, of seriously debilitating the health of the bush and it is therefore easily conceivable that failure to tackle this problem vigorously may lead to serious results.

Termites :—Depredations by termites, hitherto believed as being confined to the Anamallais, has also been reported from Mundakayam during the year under report. The termite from the latter district was tentatively identified as *Coptotermes* sp. The pest was reported as being widely prevalent on an estate from which specimens were received, but it was found that 'wood-rot' was also associated with the trouble. The termite depredation had, however, extended to green wood.

Although this species of termite is capable of attacking living tea bushes, it is still necessary that dead-wood should be available for the initial infection. 'Wood-rot' patches and 'die-back' in branches after pruning offer themselves as convenient points of entry into the bush. If the insect could be deprived of such wood, which is its only means of entry above ground, its attacks could be minimised to a very large extent.

Prevention of 'wood-rot' and 'die-back' after pruning and the elimination of tree stumps from cultivated areas are the only means by which relief may be obtained at present, as no other successful measure of a direct nature is yet available against *Coptotermes*.

Reports from the Anamallais show that termites are as serious as before, attacking living tea bushes and causing considerable damage. Two species are involved in the depredation in this district, one being *Coptotermes* sp. and the other *Calotermes* (*Glyptotermes*) sp. nov., the latter species probably predominating. The specific identities are still undetermined for want of adequate specimens.

Calotermes (*G*) sp. nov., being very similar to *C. dilatatus*, B & P., of Ceylon, control measures such as are being attempted in Ceylon against *C. dilatatus*, may also prove to be beneficial against this species. To start with, injection of Paris Green into the attacked bushes should be given a fair trial in the Anamallais. Should it prove unsuccessful, other methods of combating the pest will have to be considered.

Red Coffee Borer : —(*Zeuzera coffeae*, Nietn.). This insect commonly known as the Red Borer of Coffee was one of the conspicuous pests of the year as judged by the number of enquiries received. The reports emanated mainly

from Central Travancore and the Anamallais. A short account of the pest and its control has already been published in the Planters' Chronicle of 9th February 1935 (p. 53).

Fortunately, attacks of Red Borer are so far confined to isolated bushes in a field and the pest has shown no tendency to appear in numbers capable of effecting widespread damage. It is mostly noticed during pruning and the simple methods of removal and burning of attacked branches or of injection of petrol into the tunnel if the injury has extended below the pruning level, should be sufficient to check the pest under the present circumstances.

Nettlegrubs :—The year generally may be said to be free from Nettlegrubs and no serious outbreak was reported from any of the districts where these pests have a wide distribution.

Red Slug :—(*Heterusia virescens*, Butl.). Red Slug was once reported as occurring in small patches of tea on an estate in Central Travancore. This insect, though having a wide distribution in South India, is yet only a minor pest of tea and is presumably kept in check by the activities of parasites, the chief of them being two or three species of Tachinid flies, of which one is identified as *Sturmia* sp.

Control measures as are indicated in the Annual Report for 1932/33, p. 47, may be undertaken in case the pest appears in large numbers and threatens serious damage.

Twig Caterpillar :—(*Ectropis bhurmitra*, Wlk.). The mass outbreak of this insect referred to in last year's report in which it was mentioned that a lull occurred during the middle of December, was subsequently reported from the estate as having had a recrudescence of attack in fresh fields in the early part of January, the attack terminating by about the end of the same month. Nothing has been heard of it since. There could be little doubt that the collection of pupae energetically undertaken by the management by employing a gang of 150-200 coolies on certain days was largely responsible for this and a glance at the following figures referring to the work of collection should give an idea of the magnitude of the task of control rendered necessary by the pest.

Duration of the pest	..	16th October to 23rd January.
Area infested	..	392.81 acres.
Pupae collected	..	4,624 lbs.
Pupae per pound	..	1,200 approximately.

The above figures of pupae, it should be remembered, represent only the remainder after making allowance for the eggs destroyed by parasites, the larvae which succumbed to the effect of climatic factors and natural enemies and the pupae which were destroyed by pigs.

Lobster Caterpillar :—(*Stauropus alternus*, Wlk.). What was believed to be this Notodontid was reported as the cause of extensive damage to young nursery plants on an estate in Central Travancore.

It is generally a scarce insect, noticed once on tea in Mundakayam in conjunction with an outbreak of Nettlegrub, and again on Red Gum in the Nilgiri Wynaad. There has so far been no occasion to undertake any control measures in dealing with this insect. When found necessary, handpicking, which is a simple matter, may be done and would suffice to act as an adequate check.

Scarlet mite :—(*Tenuipalpus obovatus*, Donn.). An infestation of a mite tentatively identified as the above was reported from the Nilgiris. Being confined to isolated patches the damage was not considered serious enough to warrant control measures.

Sulphur dusting appears to have been tried on the affected estate but doubts are expressed whether the recovery of the bushes was due to this operation or the commencement of the rainy season which is also known to exercise a check on the activities of mites.

Maggots in Tea Seed :—Fly maggots were reported from an estate in Central Travancore as being fairly common in a consignment of tea seed from a local seed-bearing area. In the material sent in for report, puparia of two different sizes, indicating the presence of two species, were present but as they were all dead, there was no possibility of being able to obtain the adult flies for correct identification.

It appeared as if the maggots had gained entry into the seed after the shell had cracked, the seed subsequently rotting. It was considered rather unlikely that they could attack healthy seeds under natural conditions.

Brown Bug :—(*Saissetia coffeae*, Wlk.). An infestation of Brown Bug was once reported from the Nilgiris. Although sporadic attacks have been previously on record, the exact status of this insect as a pest of tea has remained undetermined as definite information is not available yet regarding its distribution and severity in the affected district.

An account of the pest and its control appeared in last year's report (pp. 41-42).

GREVILLEA.

Xyleborus semigranosus, Bldf. and *Xyleborus andrewesi*, Bldf. were reported as attacking Grevilleas on the Anamallais mainly between three and five feet above ground, the former species predominating.

Both the species appear to prefer fresh moist wood for their boring but it is most unlikely that they are capable of attacking healthy trees and causing their death. As in every previous instance of these borers reported from the Anamallais, a root disease caused by a fungus was considered the primary cause and the attack of the borers a subsequent occurrence.

Weevil Borer :—(*Pagiophloeus umbricidus*). The Manager of an estate in Mysore wherein this pest appears to have taken a strong foothold, reported again this year that a very large number of Grevilleas have been killed. It was desired to ascertain the sites chosen for egg-laying but as it was not known whether the emergence of adult weevils was taking place at the time the report came in, some doubts were felt whether any visit, undertaken then, would be helpful in investigating the habits of oviposition. The visit had therefore to be deferred till such time as definite information was available regarding the flight period of adult weevils. It is hoped that this investigation may be possible during the coming year.

GLIRICIDIA.

Pseudococcus sp. was once reported from an estate in South Travancore as attacking and killing the fresh young foliage of Gliricidias appearing after wintering, thereby seriously inhibiting growth.

Although mealy bugs evidently affect the growth by retarding the formation of new shoots, still it is unlikely that they cause serious injury to the plants unless present in enormous numbers. Normally vigorous plants growing under suitable conditions can usually throw off the infestation after a time and are often aided by parasites and predators. If, however, the vitality of the plants is impaired as a result of disease or unsuitable soil or climatic conditions, the mealy bugs may increase rapidly, in which case spraying with a contact insecticide such as Kerosene emulsion or Fish-oil-Resin soap has to be resorted to.

In the case under report, an hymenopterous parasite and the larva of a Lycaenid butterfly were found to occur as natural enemies but to what extent they exercised control on the pest was uncertain.

DADAP.

'Ringer':—A species of Lamiid beetle, probably *Sthenias grisator*, Fb., was found girdling the branches of Dadaps by ringing them completely as the result of biting through the bark, thus causing a 'die-back' of the portions above the 'ring.' Its depredation was mainly noticed on Dadap cuttings planted a few months previously but was also evident on the older Dadaps on the estate. Branches of varying thickness varying from less than an inch to about an inch and a half in diameter, were found attacked, their severance from the main stem depending on their own thickness and also probably on the position where the 'ring' was made. The beetle by its own activity may cut into two stems of about an inch or less in thickness but not those stouter than an inch. The latter, however, may also break off from the main stem by their own weight, if the 'ring' is made at a low level in the case of the planted cuttings, or near the axil where the branch has taken origin in the case of older Dadaps.

The height above ground level at which the beetles 'ring' the stem is also variable, as instances were met with where they have 'ringed' the stems as low as 2 feet above ground and branches as high as 15—20 feet in the case of older Dadaps.

In common with the grubs of other Lamiid beetles, which are generally feeders on dead wood, the grubs of this 'ringer' are also probably intolerant of sappy wood. The 'ringing' therefore appears to be done by the parent beetle mainly with a view to arrest all flow of sap to the regions above the 'ring' and so ensure that the eggs that are laid in the branch thus killed hatch out successfully in the larval tunnel and feed therein, free of, and undisturbed by, the ascending flow of sap.

The completely 'ringed' branches that fall to the ground also afford the necessary breeding material for the grubs that hatch out of eggs laid on such branches prior to their severance from the main stem. Grubs of different stages were found boring inside such fallen branches and as many as 8—10 adult beetles were found to emerge from each branch.

The life history of this pest has not been worked out so far and the details such as the duration of the different stages, the flight period of adult beetles, their longevity and oviposition habits, so essential for devising adequate control measures are yet unknown. These aspects of the investigation are receiving attention and the breeding work is in progress.

In the matter of control, only the collection of beetles whenever found and the cutting and destruction by fire of all girdled twigs (to eliminate eggs and larvae breeding therein) can be suggested at present.

Shoot Borer :—(*Terastia meticulosalis* Gn.). This Pyralid caterpillar was the cause of 'die-back' in several Dadap cuttings a few months after planting on an estate in the Nilgiri-Wynaad. As this borer occurs probably throughout Southern India wherever Dadaps are grown, the following short account of the insect and its control is included here.

The eggs which are oval, soft and whitish are laid singly at the bases of leaf stalks and the emerging caterpillar first bores into the tip of the young shoot and gradually tunnels downwards thereby causing the shoot to die back. The caterpillar is creamy white with large flattened shining brownish warts from which arise short hairs and measures about $1\frac{1}{4}$ inch when full grown. After about a month of feeding, it transforms itself into a cocoon inside the hallowed out shoot itself. The greyish brown moth emerging therefrom can be recognised by its upturned tip of the abdomen and the rather narrow forewings not completely covering the hind wings.

Its depredation, as already pointed out, results in the dying back of the infested shoot. The 'die-back' of the first shoot usually causes the plants to throw out several side shoots, but sometimes these secondary shoots may also be attacked.

This pest can usually be controlled by cutting back the affected shoots to sound wood and burning the cuttings so as to destroy the insect that may be present therein either in the larval or pupal stage.

Mealy Bug :—(*Pseudococcus* sp.). An infestation of mealy bug has been observed at the roots of Dadaps. Although these insects suck the juice from the plant and thus cause injury to the growing plants, adequate evidence was not forthcoming to suggest that these insects were primarily responsible for any serious injury. Heavy infestations, however, were noticed on a few plants but it was considered that the impaired vitality of these plants as a result of other causes was the main factor in encouraging these insects.

Normally, no special control measures should be necessary in dealing with these mealy bugs. Their presence is only an indication of the impaired vitality of the plants brought about by the attacks of other insects or disease or by adverse climatic conditions. Attention to these and to proper cultivation should generally remedy the mealy bug trouble.

Myllocerus viridanus, *F* :—Dadaps in South Travancore have been noted swarming with the above weevils which had attacked the young shoots on the recently planted cuttings. The older leaves were also nibbled at the edges. At the same time, a large number of other plants were also found to harbour these insects. Tea beneath the attacked Dadaps, although giving lodgement to them was not found to have been affected.

Very little is known about the life history of this weevil. The eggs are presumably laid in the soil and the grubs feed on the roots of plants. After pupation, the adult weevils emerge from the soil, generally in large numbers in a particular season of the year, when they may attack the foliage of a wide range of host plants.

RED GUM

Helopeltis antonii, Sign. continued to be the worst pest of Red Gums during the year on the Experimental Station. The tender shoots of all the young plants suffered very badly while the older plants appeared to remain comparatively free from its depredation. The damage done to the tender shoots of Red Gums by this insect take a much more severe form than that of *H. theivora* on Tea. Being more succulent than tea, a greater length of the shoot dies back as a result of injury and gaping cankers are produced in regions where eggs are deposited.

Other sucking insects noticed during the year were an Aphid, a Cerocopid and a Membracid. The first, which is smaller than the Tea Aphis, occurred on the tender foliage and caused severe stunting of growth. The Cercopids were abundant on some plants during the dry months. Their nymphs live concealed in masses of frothy matter produced by themselves from a mixture of liquid excrement and waxy secretion, these white masses being commonly known as 'Cuckoospits' or 'frogspits.' The adults are very active, being able to leap considerable distances. The occurrence of the Membracid bugs was less common. Although they were noticed feeding on the plants and laying eggs embedding them in a series in the tissues of the soft shoots, the damage done was on the whole very little.

Termites were alleged to have caused serious damage on a few estates in Central Travancore and Nilgiri-Wynaad. In the former district, the seedlings planted at the beginning of the South West monsoon appeared to have died out in large numbers. Satisfactory evidence is still not forthcoming,—in spite of efforts made in that direction,—to prove that termites kill the young seedlings. The specimens of the insect are not available yet but the mere evidence of their damage seen on the roots cannot obviously be taken as sufficient proof to conclude that they are guilty of primary depredation.

A few caterpillars closely resembling Lobster caterpillars of tea (*Stauropus alternus*) were found to feed on red gums. A pair of Atlas moths (*attacus atlas*) were found *'in copula'* on a young plant, one of them, probably the female, having emerged from a cocoon present closeby attached to the same branch as where the moths were resting. The eggs laid under captivity (183 in number) have hatched out in about 10 days and the caterpillars are being bred under observation.

CROTALARIA.

Report of a fairly serious damage to young Crotalaria seedlings caused by Grass-hoppers came from Peermade. As the insects accompanying the report were in the immature stage, an exact identification was not possible.

It is the first instance that has come to notice of Grass-hoppers seriously attacking Crotalaria, though these insects, generally polyphagous in habits, may sporadically attack any low-growing plants. Collection of hoppers by hand nets, application of poison-baits containing Paris green and deep forking of infested fields to expose the egg masses to the heat of the sun and the predatory birds were suggested for control, but how far the damage warranted the adoption of control measures was not definitely known.

Shot-hole Borer (*Xyleborus fornicatus*, Eich.) is also capable of attacking Crotalaria in Central Travancore where on an estate in that district it was found that these plants growing in the vicinity of Shot-hole Borer infested tea were also found infested.

Identifications :—A number of insects were identified during the year through the courtesy of the Imperial Institute of Entomology, London. Many of them being confirmations of the tentative identifications made prior to forwarding them for expert naming and already dealt with in previous reports, mention need only be made here of a few important parasites occurring on some of the common pests of South India in addition to those already reported in previous years.

1. *Dioctes* sp. (Ichneumonidae)
2. *Tetrastichus* sp. (Eulophidae)

} on *Gracilaria theivora* (Tea Leaf-roller).

1. *Opius* sp. (Braconidae)
2. *Trigonogaster* sp. (Pteromalidae)
3. *Closterocerus insignis* Waterh (Eulophidae)

} on *Oscinis theae* (Tea leaf miner)

1. *Brachymeria* sp. (Chalcididae) on *Homona coffearia* (Tea Tortrix)

REPORT OF THE MYCOLOGIST

1936-37

Advisory :—There was no increase in the number of specimens received during the year. A large proportion of the specimens were of various weeds growing on estates, these being received for identification. No serious disease was recorded except the *Cercosporella* disease reported from the Nilgiris and the Anamallais.

Touring :—Except for two short visits paid to investigate the causes of a leaf disease prevalent on an estate in the Nilgiris and of a root disease of *Acacia* in the same district, no touring was undertaken.

Leaf Diseases

The Cercosporella Leaf Disease :—This leaf disease was described in some detail in the report for 1935-36 and during this season has been recorded from estates on the Nilgiris and the Anamallais. The disease occurred during the rainy season when misty weather, rather than actual precipitation, was prevalent.

An opportunity was afforded to study the disease on an estate in the Nilgiris and the following notes are based on the observations then made. Bushes attacked by this fungus were partially or completely defoliated according to the intensity of attack. On partly defoliated bushes, the leaves bore circular yellowish brown patches of different dimensions. More than one circular patch was visible on most of the leaves, these patches often fusing together thus affecting the entire surface of the leaf.

A white powdery mass of conidiospores could easily be dislodged from the leaf surface and this accounts for the rapid spread of the disease under favourable conditions of moisture and wind.

Dead leaves which had fallen beneath the bushes were examined and these also bore the fungus and its spores. On some of these leaves small reddish brown spherical masses were present and on examination they resembled perithecial structures. These however were sterile and empty.

Cultural studies started during the last season were continued and fresh isolations were made from material as it occurred. Their behaviour under artificial conditions was described in last year's report. Success has not resulted in the attempts made to produce the perfect fertile perithecial bodies on various sterilised vegetable parts or agar-media. The perithecia produced on both these media have been sterile.

Propagation of the fungus, therefore, appears mainly dependent on the conidia produced. It is likely that the sterile perithecia produced occasionally on dead leaves serve a similar purpose as the sclerotia in some other fungi such as *Corticium* spp. These might remain inactive during dry conditions and under favourable circumstances regain life and help the fungus to spread rapidly by the production of the conidia. The presence of fatty matter within the sterile perithecia lends further support to this view.

Control measures against this disease have been indicated in the report for 1935-36.

Black Rot :—(*Corticium invisum*). A single instance of its occurrence on an estate in Travancore was received but there is no doubt that this disease is prevalent on estates in other districts, especially those exposed to heavy rainfall.

Red Rust :—(*Cephaleuros mycoidea*). Although reference has not been made in previous reports, this disease is not quite new to South India. It has not however been of any great importance. This disease is not caused by a fungus but by an alga—*Cephaleuros mycoidea*. It is popularly termed Red Rust because of the rusty colour of the alga and has no relation to the Rust diseases of economic plants such as the cereal rusts, or the coffee rust, the latter caused by a fungus *Hemelia vastatrix*. A few specimens of leaves received from an estate in Travancore bore patches of the Red Rust alga, these specimens were in addition attacked by Brown and Grey blight organisms and bore indications of having been attacked by some insects also.

A certain amount of damage was attributed to Red Rust during the early period of the tea industry in North East India but it has now come to be realised that with attention being given to the health of bushes, good drainage, balanced manuring and the encouragement of free circulation of air, bushes might be kept free from attacks of this organism. In other words neglect of operations that go to maintain bushes in normal health renders bushes weak and susceptible to attacks of this parasitic organism. Debility might also be caused by other parasitic agencies, that have disappeared owing to adverse climatic conditions and the alga might attack bushes thus weakened. In the present instance it was considered that the debility was the result of an attack from *Helopeltis*.

The Red Rust patches occurred on the upper surface of the leaves and were situated mostly near the midrib in a circular manner. The surface of these patches was covered by fine reddish brown hairs bearing on their tip spore like bodies,—the sporangia.

There exist two distinct types of the alga, one of them *C. mycoidea* being epiphytic on the leaves and the other *C. parasiticus* parasitic on the leaves and stems of tea. The latter has been observed in South Travancore but has never been the subject of enquiry.

As indicated earlier, this organism appears occasionally on debilitated bushes. It has sometimes been observed on leaves of bushes due for pruning. There is at present no indication that it has been the cause of any serious damage to crop. Consequently remedial measures have not been suggested here, but in general avoidance of this disease is generally accomplished by improved agricultural practices.

Leaf Scorch :—The occurrence of scorched leaves and twigs during drought periods is common knowledge. Such scorching occurs to a greater degree on estates that have insufficient shade. It is also possible that certain soil types are more easily affected by drought and show more scorching than others. On some of these scorched leaves an olive brown fungal growth has often been observed belonging to a *Monilia* type of fungus. Examination of leaves in various stages of scorching has disclosed that the fungus is preceded by the appearance of a sticky secretion of some nature on which the fungus probably develops. The nature of the secretion on the leaves is till undetermined.

The presence of this fungus has been observed on specimens coming from several estates. The fungus does not appear to be harmful and should therefore not cause any anxiety, where such growths occur. No remedial measures appear to be needed.

The scorching however considerably reduces the vitality of the bush and die back is not uncommon on such bushes. Much of this trouble is due to climatic factors and adequate shade and cultivation should minimise the effects of drought.

Witches Broom Disease :—This disease has not shown any tendency to spread. *Bushes that had been treated have not assumed their normal growth but continue to show chlorotic leaves and shortened internodes.

An attempt is being made to study the leaves cytologically to observe differences that might exist between healthy tea leaves and diseased ones. For this purpose leaves from affected bushes were fixed in certain fixing liquids and after imbedding them in paraffin, sections were cut, stained and examined. Although work on this line has not made much progress certain significant differences have been noticed. The chloroplasts in the diseased leaves are small and few in number, there also appears to be some difference in the shape of the healthy and the diseased chloroplasts. In the palisade cells of the diseased leaves numerous yellowish brown globular bodies occur, which are often tinged with a light green colour. The bodies are of various sizes. They do not appear to take any stain but retain their colour even after bleaching in various reagents for more than 12 hours. Such bodies are not peculiar to the palisade cells alone but are occasionally seen in the spongy tissue also, but their numbers in the latter are few. The nuclei do not show significant differences in healthy as compared with diseased leaves, but further examination is necessary to confirm these tentative observations.

The striking difference between a healthy and a diseased leaf that has at present been noticed however is in the presence of the yellow body and meagre development of the chloroplasts in the latter.

Work on this subject will be continued.

Minor Leaf Diseases :—Brown and Grey blight organisms have been reported occasionally. The former (Brown Blight-*Colletotrichum Camelleae*) has sometimes seriously affected tea plants in nurseries.

Stem Diseases

Pink Disease :—(*Corticium salmonicolour*). Results of the investigations on this disease were published during the year in the form of a bulletin.

Fusarium on pruned branches :—Specimens of pruned branches have been found infected with a species of *Fusarium*. The fungus itself was present as an orange coloured crust on the surface of these affected branches. Isolations from such branches produced both a *Fusarium* and a *Cephalosporium*. Branches showing this fungal growth were dead and it is possible that the fungus having entered through the pruning cuts has caused the damage. Protecting pruning cuts should prevent the infection and eliminate the cause of die back.

Staining of tea wood :—Tea wood from die back shoots or from branches subject to wood rot (Branch Canker) shows a reddish discolouration. The

* Annual Reports for 1934–35–36.

wood gives the appearance of having been steeped in red ink. Several isolations were made from such stained wood, and the fungus most commonly obtained was a *Fusarium.*

Isolated cultures from the above when grown on agar media produced a similar reddish discolouration in the media. Transfers have been made to sterilised wood blocks to observe if the growth of the fungus produces the reddish discolouration in these blocks.

Treatment of pruning cuts :—During the year an experiment has been commenced to observe the efficiency of some of the common antiseptic paints that are commonly employed for application to pruning cuts. Tar, tar products (Mason's mixture, Skene's wax, Carbolineum, and Cargillineum) and a mixture of dung and clay have been used. The applications were made immediately after bleeding at the pruning cuts had ceased. Observations on the permanency of these agents were made for a number of months and these will be examined again at the time of the next pruning.

The dung and clay mixture dropped off either on drying or owing to exposure to the showers that followed their application. The mixture was made by taking equal quantities of dung and clay, pounding them with water to a plastic consistency. Other ingredients which might have been included in the mixture were aloes, resin and asafoetida, but these were not used as they were not locally available at the time. Whether the adhesive properties of this mixture would have been improved with these other ingredients is difficult to say at present.

Some of the other protective agents employed, viz., Mason's mixture, Cargillineum and Carbolineum could be used without any necessity for these being warmed, but others—Tar, and Skene's wax required not only preliminary warming but showed a tendency to thicken thus requiring rewarming before use. Carbolineum and Cargillineum appear to lose their colour after a month due perhaps to the effects of both the sun and the occasional showers. Mason's mixture however needed neither preheating nor did it lose colour in the rain.

Since, to some extent all the tar products here employed could be classed as water proof, from this standpoint there is little to choose between them. In estate practice where one uniform paint is generally employed fading out of the colour might not be of much concern. A product however that could readily be applied without frequent warming would save much time and labour and in this respect any one of the three Carbolineum, Cargillineum or Mason's mixture should prove useful. If constant checking is needed then the retention of colour by the product applied is an advantage. Mason's mixture has so far stood the test well both because of its ready applicability without preheating and its retention of colour.

Wood Rot :—*Avoidance and Treatment.* Suggestions have been made by Planters that the damage due to sun scorch when tea is pruned during hot weather might be avoided by the use of an antiseptic paint on the exposed horizontal branches. The practicability and efficiency of such a procedure was considered doubtful but the idea is being investigated experimentally.

It is believed at present that full exposure of branches to the rays of a strong sun causes the death of the bark, the subsequent development of the branch as the bush passes through the tipping stage causes a rupture of the dead fragments of bark and these cracks form a convenient breeding ground

for wood rotting fungi. It would seem therefore that it is not an antiseptic paint required but one that will prevent the bark drying and splitting. It was considered likely that black dressings would probably increase the effect of the sun but that white might have a slight cooling effect.

An experiment on these lines was put into effect. A plot due for pruning, on a steep slope facing the afternoon sun, was pruned so that as many branches as possible were left facing the maximum intensity of the sun. As far as possible it was arranged that the subsequent removal of branches, which might become affected by branch canker, would be possible without ruining the existing frame. One of six treatments was given to chosen branches on every suitable bush as follows :—

A	B	C	D	E	F
White Wash	Skene's Wax	Check No Treatment	Mason's no Mixture	White Paint	Tar

Bushes treated with a black paint alternate either with a no treatment bush or with a bush receiving a white application.

These treatments should prove instructive. Skene's Wax and Mason's Mixture are antiseptic but black. Skene's Wax gives a thicker and more plastic coat which is less likely to crack with the expansion of the stem. Tar is black and antiseptic but slightly corrosive. If heat is the prime destructive agency than Mason's Mixture and Tar should produce more branch canker than in the controls. White paint on the other hand should be either neutral or cooling and thus minimise the effect of heat as compared with a black surface, but it has no appreciable antiseptic properties. White Wash has been included as a cheaper although less effective white covering. No adhesive was mixed with this and as a result the abnormally early rains washed most of this off any branches which were not yet sheltered by new growth.

A point which is also under observation is the extent to which these paints will restrict the formation of buds.

It is hoped that when the tea reaches the tipping stage it will be possible to make counts of the cankers produced and of the buds which have come through the protective coating. At the time of writing it is clear that in most cases the black dressings have prevented the emergence of buds from treated areas of bark while white paint has not produced so marked an effect. Also the first signs of canker production are visible on some of the bushes.

This experiment should demonstrate the cause of branch canker and provide a guide as to what will and what will not help in its avoidance.

Treatment of Wood Rot :—This experiment was undertaken on tea growing practically on level ground. Bushes showing the incipient wood rot areas were marked out before the treatments. None of the bushes show any exposed wood due to rotting but instead small sunken oval areas were present on the horizontal branches and were situated some distance away from the pruning cuts. The bark was dead as also part of the wood. The following treatments were undertaken :—

(*a*) Some bushes were left without treatment to serve not only as checks but for further observations as regards the progress of the rot itself.

(*b*) The sunken areas were treated with a protective paint (Skene's Wax) without the dead tissues being removed. The object of this experiment being to observe if by such an application the decay could be arrested.

(*c*) Affected tissues were scraped out by means of knives to healthy good wood before the protective paint was applied. This double treatment is the common recommendation when wood rot occurs and had developed to its later stages. The scraping of the dead and discoloured tissue is carried out to eliminate any disease organism that might be present in the affected region. After its removal the protective paint was applied to prevent further infection.

(*d*) Instead of the dual treatment described in (*c*) only the scraping of diseased tissue has been done leaving the scraped surface improtected, this experiment should throw light on the question of the need for applying a protective paint.

All the four treatments require re-examination when the area is again due for pruning.

Galls and Cankers :—From an estate in Travancore specimens of tea branches bearing gall-like outgrowths and cankers were received. The galls were individually a few millimeters in diameter but several of them were found fused together especially at the nodes. The cankers were characteristic of those produced after attacks of Pink Disease. On the affected parts neither an insect nor a fungus was evident although it was considered that the damage was the result of attacks from both the agencies. Practically all the branches bore these two types of damage. The suggestion has been made that the damage was due to constant attacks of *Helopeltis* and *Corticium salmonicolor*. Frequent bites of the insect have probably produced the gall-like growths and the cankers by similar attacks of the fungus. Severe pruning out of all affected parts and attention to cultivation methods were suggested in view of the large area involved.

Burrs :—Larger sized Burrs, some of these measuring 4″ to 6″ in diameter, were received from an estate. Beyond the explanation offered in the previous report (1935-36) our knowledge regarding such malformations has remained obscure. In Rubber larger burrs are reported to occur but, there, definite damage is done to the bark by tapping which might induce such abnormal growths, in the case of tea it is not known if pruning brings about these formations under any particular conditions.

Root Diseases

No new root diseases were recorded during the year. An estate where *Rosellinia* was doing damage was recommended the use of bazaar alum for sterilising the soil and the results are not yet available.

On supply plants *Rhizoctonia bataticola* was recorded, and there being no other organism associated with this, the damage was attributed to this and to drought conditions that existed at the time the specimens were received.

Isolations made from these roots indicated that in size and shape of Sclerotia they did not differ much from those isolations made on previous occasions. A brief account of this disease was given in the Mycological report for 1934-35.

Death of Bushes due to nonpathogenic causes :—During the year several instances of bushes either dying out or showing poor development yet possessing no disease organism on either on the roots or the stem were recorded. In the majority of such cases the root growth was anything but normal. In some, a good tap root was wanting and in its stead several short laterals had arisen which instead of penetrating deeply appeared to lie superficially in the upper layers of the soil. They were generally twisted and had a tendency to develop towards the surface. Excessive fibrous beard-like rootlets were a constant feature in some of these cases.

The surface of a normal healthy root is generally smooth but in the cases under review they bore a roughened appearance due to the presence of lenticel-like openings on the bark.

Poor development, and in some instance the death of such bushes in the absence of the known root disease fungi on them was attributed to a deficient root system, and bad soil conditions that have induced the development of the abnormal features detailed above.

A profuse development of secondaries with little or no tap root growth appears to indicate the presence of a hard pan or some hard rock which the roots have met with the result that they have not been able to develop to their normal length. With the cessation of the growth secondary roots have arisen to meet the demand, their success depending upon the permeability of the soil to lateral growth. Where the surrounding soil has been loose the roots have developed to their normal length but if this were not so they have tended to grow upwards in an abnormal manner.

The development of fibrous rootlets in profusion is also an abnormal feature and it is likely that under conditions described above and when the requirements of the plant have been made available nearer the surface, e.g., by superficial manuring such a profuse growth is induced.

The lenticel-like scars on the roots are perhaps developed when bushes are growing on ill drained swampy soils and the pores might serve the purpose of accessory breathing.

Various other causes might be present bringing about such abnormal developments but at present these are some of the factors that are known to produce such effects.

Bushes having such root growth make only a feeble recovery after pruning, or tend to die during dry weather. The non-recovery could be attributed to lack of sufficient reserve food to encourage fresh growth. Their death during dry weather could be accounted for by the demands for water supply being so great during dry weather, that the deficient roots are not able to meet this large demand because of their superficial growth with the result that the plants gradually wilt and die.

It will be seen from the foregoing that the causes are physiological and immediately bound up with soil conditions and root growth. Any measures undertaken to improve soil conditions should act beneficially on the root growth. Deeper cultivation and proper manuring have generally been recommended when cases of deaths from deficient root system have been reported.

Nursery Diseases

Eelworm infection of the roots of nursery plants was the major trouble reported on nurseries. Occasionally however minor leaf diseases mostly the Brown (*Collelotrichum*) and Grey (*Pestalozzia*) blights were present. When attacks from the latter were more prominent, spraying with a fungicide (Lime sulphur) was recommended, in addition to improving the health of plants by the use of suitable manures.

Green Manure and Shade Crops

Crotalaria anagyroides :—A leaf disease characterised by the presence of black spherical structures on the surface of leaves was recorded. These spherical bodies were of the size of large pinheads and represented the perithecial fructifications of the fungus—*Parodiella grammodes*. The fructifications were present generally on the upper surface but instances of their occurrence on the under-surface of affected leaves were by no means rare.

As a result of attack the plants are almost completely defoliated. Such a disease has been reported from Java and Ceylon and probably occurs elsewhere also. Information available indicates that certain of the species of *Crotalaria* are susceptible to attacks of this fungus. It is likely that the fungus is borne through the seed and thus propagated but no definite experiments have been conducted to determine this point.

In view of the expense involved, spraying does not appear to be a practical possibility. The alternative suggestion is to grow a crop that is resistant to this fungus, but experiments in this line should be conducted before definite recommendations are made. There appear to exist however species of *Crotalaria*, that are immune to attacks from *Parodiella*, and such resistant species could be employed as a substitute for *C. anagyroides*.

There is however no possibility of the disease being transferred to tea, as the latter is immune to attacks of this fungus.

Fusarium Wilt :—The same species of *Crotalaria* was found attacked by a species of *Fusarium* causing the affected plants to wilt. The fungus was found on the roots. On the surface a white mycelial growth was visible and in the interior the wood was found discoloured and emitting a mouldy smell. The fungus bore *Fusarium* and *cephalosporium* spores.

Several of the leguminous crops are susceptible to attacks from this fungus and where the affected crop forms the main product a regular rotation of crops is generally recommended to ward off trouble from 'Wilt.' In tea where this is grown for manure it is doubtful if such a practice is at all possible. Since fungi of this type dwell in the soil for considerable periods, the only possibility of eliminating the "Wilt" is to allow tea soils that have shown this fungus on *Crotalaria* to lie fallow (with regard to this crop) for a couple of years before planting it again with green manure seed.

Acacia decurrens :—On an estate small trees of this species were found showing signs of a debilitated growth, or were dead. The plants were mostly in the open, planted to serve as wind breaks. The surface of the bark of these indicated a prominent development of the red perithecia of *Nectria*. The fructifications were found produced even on some of the exposed roots. The wood showed generally a greyish discolouration.

The roots were situated rather superficially and in some cases infections from *Rosellinia* were evident but this was not always so.

An interesting feature of most of the trees was a damage that was perceptible at the region of the collar. It was considered likely that the infections of *Rosellinia* originated from this region and spread to the roots. Support was forthcoming for this assumption from the growth the fungus had made. The deeper roots and those parts away from the collar were in apparently sound condition while those nearer the collar were found diseased.

The presence of *Nectria* was attributed to debility caused by lopping of the trees for green material, the fungus having entered probably through the lopping wounds. In cases where both *Nectria* and *Rosellinia* were present, the death of such plants was primarily attributed to *Rosellinia*.

To such plants that showed the Nectria on the stem, cutting back to healthy wood and treating the cut surface with an antiseptic was suggested. Where *Acacias* were attacked by root diseases, it was suggested that they be removed and the soil treated with about 12 ozs. of bazaar alum.

Grevilleas :—An ascomycetous fungus *Tryblidiella rufula* was found on some Grevillea branches. The same fungus was found on some *Citrus* shoots also that had been previously attacked by *Corticium salmonicolor*. The fungus has been isolated and further work is proceeding. An almost similar fungus has been noticed occasionally on tea branches that had succumbed to attacks from Pink Disease. It is claimed that the fungus on tea is a different species. A search is being made to obtain the fungus on tea for purposes of comparison.

Dadaps :—Die back and Bark rot of *Erythrina* were recorded from some estates, these were caused by species of *Fusarium*. Details have been given in the Annual Report for 1935-36.

Botanical :—Several specimens of weeds on estates were received for identification and this has been done as far as possible. Exact identifications were sometimes not possible on account of lack of flowers on the specimens. Since these plants have sometimes to be sent to authorities elsewhere, planters forwarding such specimens are requested to send them with flowers pressed between sheets of blotting paper. It will be of advantage if additional information, especially regarding their habit, time of flowering, elevation where growing and such other relevant details are also given.

An attempt has been made to start a herbarium at the Station and it is hoped to augment this gradually as material becomes available.

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